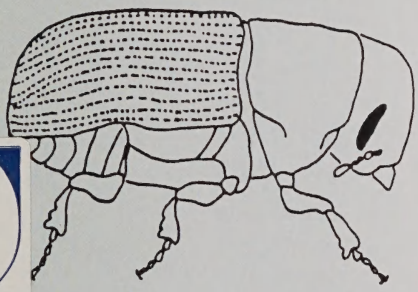
United States Department of Agriculture
Forest Service
Northern and Intermountain Regions

Douglas-Fir Beetle in the Intermountain West



A group of Douglas-fir beetle killed trees may number from a few to several hundred

Introduction

The most important bark beetle pest of Douglas-fir is the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins. Beetles infest and kill their host throughout most of its range in western North America. Western larch may be attacked during beetle outbreaks, but brood development in larch is rare. At low population levels, beetles maintain themselves in windthrown or injured trees, or those infected with root diseases. In endemic conditions, tree mortality may be widely scattered throughout a stand or watershed. Epidemics—almost always associated with some type of stand disturbance such as blowdown, defoliation, fire, or drought—can build rapidly and kill hundreds to thousands of mature Douglas-fir in stands or drainages. Beetles are attracted to downed or weakened trees and are capable of multiplying quickly due to lack of host resistance. Beetle populations at higher than normal levels then overcome live, relatively healthy trees nearby.

Outbreaks, while typically lasting an average 2-4 years, may result in 60-80% of the Douglas-fir over about 12 inches in diameter being killed in a stand or larger area. Periods of unusually dry weather may prolong tree killing in a particular area. Epidemics are more damaging in Douglas-fir or mixed-species stands that are mature to over-mature, densely stocked with a high percentage of Douglas-fir.

Description

Douglas-fir beetles go through four distinct life stages: egg, larva, pupa and adult. Eggs are oval, pearly white, and about the size of the head of a pin. Larvae are yellowish-white, legless grubs with a brown head capsule. They undergo four size changes (instars) as

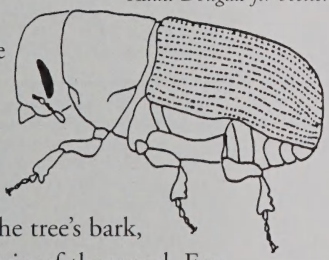
Douglas-fir beetle, egg and larval galleries.

they mature. Pupae are white and more closely resemble adults. Immature adults (callow adults) are tannish colored, but darken to nearly black with reddish-brown wing covers before emergence. Adults are cylindrically shaped, about 1/4-inch long and are relatively good fliers.

Life History And Habits

Douglas-fir beetles have one generation per year and typically take 1 year to complete their life cycle. Most overwinter as adults, emerge from their host tree and infest susceptible trees during late April to mid-June. Beetle flight period is relatively weather dependent and may be lengthened or shortened by abnormally high or low temperatures, respectively.

Adult Douglas-fir beetle.



New attacks are initiated by female beetles. Once she has attracted a male and mated, she constructs a vertical egg gallery beneath the tree's bark, paralleling the grain of the wood. Egg galleries may be up to 12 inches long and are packed with boring dust and frass. Eggs are laid in niches along both sides of the gallery.

Eggs hatch within a week or so and larvae begin feeding at right angles to the egg gallery, first within the inner bark (phloem). As they mature, toward mid-to-late August, they feed more deeply into the bark. There they construct pupal chambers, pupate, and complete their development by late summer or early autumn. Newly matured adults remain beneath the bark until the following spring when they emerge to make new attacks and renew the yearly cycle.

Evidence of Infestation

Reddish-orange boring dust noticed in bark crevices and around an infested tree's base, or along the surface of downed trees, is the first evidence of a successfully attacked tree. Standing trees are more difficult to assess because attacks may occur high on a tree's bole and boring dust may be blown or washed away before being seen. There may be clear resin streamers at the upper extremities of beetle attacks but they are not always present and do not always indicate a successful attack. Healthier trees that are attacked may "pitch out" beetles, resulting in unsuccessful attacks. Removing outer bark to reveal successful galleries and/or developing brood is the surest way to confirm successful attacks. That, however, is not always easy to do on a standing tree. Frequently a tree will be successfully attacked above a height that can be assessed from ground level.

Several months after a tree has been successfully attacked, it begins to "fade." Foliage typically turns yellowish, then reddish-orange and in a year or two, reddish-brown. After 2-3 years, most needles have fallen from the dead tree. Rate and pattern of fading is dependent on weather and individual tree characteristics. Generally, fading is not readily apparent until the spring following attack. In warmer and drier years, fading may begin by late summer or early fall after the tree was attacked.

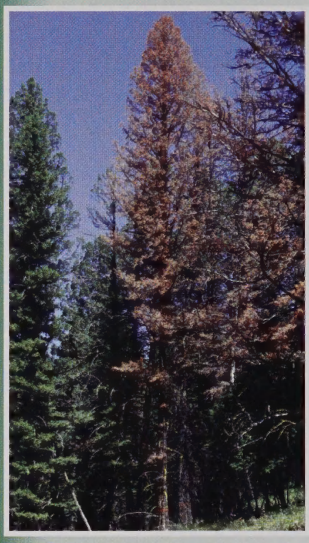
Boring dust—first evidence of successful attack.

On the other hand, some trees successfully attacked and killed, may not fade for a year or more depending upon individual tree resistance to beetle-introduced fungi.

About a year after beetles attack a tree, and perhaps continuing for two seasons, "pouch" fungi will appear on the tree's bole. These are fruiting bodies of sapwood-decaying fungi introduced into the tree following infestation by Douglas-fir beetles. While the fungi do not contribute to the tree's death, they do result in deterioration of wood immediately beneath the bark and a fairly rapid reduction in the tree's economic value.

Management Options

Because Douglas-fir beetle outbreaks are almost always triggered by some type of stand disturbance—fire, windthrow, winter damage, or defoliation—the best approach to managing outbreaks is to prevent their occurrence through timely salvage of downed or otherwise susceptible trees. Epidemic prevention is almost always more easily and economically achieved than suppression. Salvage of downed or damaged trees should occur either before



Beetle-infested trees turn yellow, then sorrel and finally, reddish brown.

they are infested, or before beetles emerge from material they have already attacked. Removed infested trees should be processed before beetles emerge at mill sites.

Silvicultural Alternatives:

Douglas-fir stands that have become over-mature, are of large diameter, densely stocked, and of a high proportion of susceptible Douglas-fir (DF) are much more likely to experience a devastating outbreak following a disturbance than stands of other conditions. Generally, stands of the following characteristics are considered "high hazard" for Douglas-fir beetle outbreak:

Typical high hazard stand.

- Older than 120 years of age
- Average d.b.h. of DF greater than 14"
- Stocking more than 150 sq. ft./ac.
- More than 50% is susceptible DF

Reducing stand characteristics to ones less susceptible to beetles, through sound management practices where feasible, will do much to maintain forest health and outbreak prevention.

Thinning, except where root diseases are prevalent, can be beneficial. Other hazard-reducing efforts may include thinning to favor non-hosts, regeneration, and/or species conversion to more seral species such as western larch or ponderosa pine (or other pine species that may be appropriate for the site).

Trap Trees: Trap trees—green trees cut and left in place, or standing trees baited with pheromone tree baits—can effectively contain existing, small beetle populations. Treated trees must be in place before beetle flight, generally by about April 1, and must be removed prior to beetle emergence a year later. Felled or baited trees should be large-diameter trees—greater than 15 inches d.b.h., if possible. Tree baits are applied at a rate of about two per acre. Felled trees should be cut in groups of 3-5 trees each, left in the shade as much as possible, unlimbed and unbucked.

Pheromones: Pheromones are beetle-produced chemicals that beetles emit to either attract a mate or affect populations to their advantage. Female beetles, making an initial attack, use attracting pheromones to attract males. Male beetles produce pheromones to attract beetles of both sexes that result in a "mass attack" to more quickly overcome host defenses. Male beetles also produce anti-aggregating pheromones that repel future attacks once a particular tree contains all the beetles it can support.

Both attractant and anti-aggregating pheromones have been identified, synthesized and are commercially available for use. When used appropriately, they can effectively manipulate beetle populations to our advantage. Attractant pheromones have been used operationally for several years in the form of tree baits and trap lures. The anti-aggregant, MCH (methylcyclohexanone), has received EPA registration for operational use, and has been used successfully to protect both stands and individual trees from Douglas-fir beetle attacks.

Conclusion

Long-term management of Douglas-fir forests offers the best means of preventing or minimizing damage by Douglas-fir beetles. Immature stands should be thinned periodically to maintain vigorous growth, reduce moisture stress, and to remove trees damaged by weather, disease, or other agents. Mature or overmature stands, growing in actively managed areas, should be considered for regeneration. At that time it may be appropriate to consider the introduction of non-host, more seral species to the site.

In non-wilderness areas, sound and timely silvicultural practices—including salvage of damaged or infested trees before beetles emerge from them—can prevent most bark beetle outbreaks. Synthetic pheromones can be effective tools in maintaining healthy forest stands.

For additional information, contact any USDA Forest Service or State Forestry office in your area.

USDA Forest Service, Forest Health Protection:

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